ENTOMOLOGICAL
SOCIETY OF
BRITISH COLUMBIA

# PROCEEDINGS

*of the*

# Entomological Society

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# British Columbia

(*Incorporated*)

NUMBER 31

*February - 1935*

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## PROCEEDINGS OF THE
## ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA

The thirty-third annual meeting of the Society was held on Saturday, March 24, 1934, in the Board Room of the Vancouver Daily Province. The meeting was called to order by the President, Mr. W. Downes. The members present were Miss M. Allen, A. W. Finlay, L. E. Marmont, J. R. J. Llewellyn-Jones, A. A. Dennys, A. D. Heriot, J. D Gregson, J. W. Eastham, H. F. Olds, R. Hopping, G. R. Hopping, W. G. Mathers, E. R. Buckell, J. Wilcox, C. H. Martin, G. J. Spencer, J. W. Winson, H. Andison, G. H. Larnder, R. Glendenning, J. B. Munro.

The minutes of the last meeting and the financial statement were read and accepted. The Society was pleased to elect two new members, Messrs. H. Andison of Kelowna, B.C., and C. H. Martin of Sumner, Washington.

The following papers were presented :

**Morning Session,** 9.30 a.m.

**Minutes, Reports, Business**

1. Presidential Address ..... W. Downes
2. Review of Applied Entomology in B.C. ('22-'33) R. Glendenning
3. The Family History of Nicrophorus conversator Walk. H. B. Leech
4. Annotated List of the Ticks of British Columbia ..... E. Hearle
5. Food Plants of B. C. Lepidoptera ..... J. R. J. Llewellyn-Jones
6. Observations on Nomenclature and Taxonomy of Coleoptera ..... R. Hopping
7. The Blister Mite and Its Blister-Making ..... A. D. Heriot

**Afternoon Session,** 1.30 p.m.

7.a A Review of Plant Quarantine Work in British Columbia, ..... H. F. Olds
8. Economic Insects of Interest of Recent Occurrence ..... W. Downes
9. Vectors of Relapsing Fever in Relation to an Outbreak of the Disease in B. C. ..... E. Hearle
10. Preliminary List of Trypetidae of B. C. ..... G. Spencer
11. Notes on Ticks and Insect Parasites of Game Animals in B.C. ..... E. R. Buckell
12. Meteorological Observations in Relation to the Spruce Budworm ..... W. G. Mathers
13. New Records of Hemiptera for B. C. ..... W. Downes
14. Ectoparasites of Mammals in B. C. ..... G. J. Spencer

15. Preliminary Report of the Coast Lizard-Tick Relationship in B.C. .....J. D. Gregson
16. Preliminary List of Tipulidae of B. C. .....G. J. Spencer

The meeting was favoured with a short address by the Deputy Minister of Agriculture, Mr. J. B. Munro, who discussed the influence of the study of entomology on the various activities in the Province.

The following officers were elected :

Honorary President .....L. E. Marmont
President .....W. Downes
Vice-President (Coast) .....G. J. Spencer
Vice-President (Interior) .....E. R. Buckell
Honorary Secretary Treasurer .....G. R. Hopping
Honorary Auditor .....J. S. Eastham
Advisory Board: Messrs. Eastham, Larnder, Lyne, Llewellyn-Jones and Marmont

Professor Spencer exhibited a book which may be the earliest publication on Entomology in Canada. It was written in 1857 by H. Y. Hind, Esq., M.A., Professor of Chemistry at Trinity College, Toronto, the title "Essay on Insects and Diseases Injurious to the Wheat Crops."

An informal dinner in the evening was attended by members and their wives.

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## ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA
## ANNUAL REPORT OF THE SECRETARY-TREASURER
## FOR 1933.

Herewith I beg to submit this report, briefly covering the activities of this Society for the past year.

### Finances

At the present time there is a credit balance of $71.15. In view of the rather thin number of the last Proceedings, this may seem a large sum but there were very definite reasons for the strictest economy. In the first place, the Government grant was again reduced and there was no definite assurance that it would be continued. Secondly, there is a very great need for a definite and constructive financial plan for this Society with a view to becoming independent and financially self-contained. Any substantial amount saved is so much toward the fulfillment of such a plan, which should be discussed at the proper time in this meeting.

### Proceedings

The reduction in quantity of material included in the last number has been mentioned with the reasons therefor. As to the calibre of the articles published it is felt that this judgment should be left to those who make use of them.

### Membership

The membership stands at approximately forty-five, the principal development being that the Society became international in character with the election of Messrs. W. W. Baker, J. Wilcox, and S. E. Crumb, of the U. S. Experimental Station at Puyallup, Washington.

### Library

Practically nothing has been done on the library in the way of cataloguing, mainly due to the fact that the library is in two places. There is provision in our by-laws for a librarian, but this office seems to have been dropped for some unknown reason. One should be elected and some one definite location established for the library. Otherwise no adequate care of it can be taken and its use will be reduced about fifty percent because no one will know where to find anything.

### Advisory Board

At a meeting of the Advisory Board held last June, the papers were selected for No. 30 of the Proceedings. The Secretary urged the other members of the Board to consider a financial plan for the Society.

Respectfully submitted,

GEO. R. HOPPING,

Hon. Sec.-Treasurer.

Vernon, B. C., February, 22, 1934.

## OBITUARY—ERIC HEARLE *

It is with very great sorrow and regret that we have to record the death, on April 17 of this year, of one of the Society's most valued members. Mr. Hearle passed away suddenly at his home in Kamloops at the comparatively early age of forty-one after an extended period of ill health due to heart trouble. Never very robust, his health was further weakened by hardships experienced during the great war in which he was seriously wounded. In his capacity as Federal officer in charge of the Kamloops laboratory, where he was engaged principally upon the study of insects affecting livestock, he never spared himself whether engaged upon research or when called upon to give the benefit of his knowledge and experience to the farmers of the district. He was possessed of boundless enthusiasm and the enforced inactivity which was necessary after the breakdown of his health early in 1933, was very irksome to him. A man of less energetic nature would have been content to take things very easily when in such a serious condition but Hearle was not of that build. After a year's rest his health seemed to be much improved and being impatient to get back to work he undertook more than was prudent, and wore himself out.

Mr. Hearle first became a member of this Society in 1919 in which year he was appointed Assistant Entomologist in the Dominion Entomological Branch and was stationed at Mission, B.C., where he was engaged upon the study of the mosquito problem in the Fraser Valley. In 1921 he commenced an investigation of mosquito control in the Rocky Mountain National Park and concluded this work in 1925. In 1926 his headquarters were moved to Indian Head, Sask., where he undertook studies of insects affecting livestock, remaining there for two years. In 1928 it was found necessary to establish a laboratory at Kamloops where livestock insect investigations could be carried on and Mr. Hearle was placed in charge. From this headquarters studies of ticks, warble flies, blackflies and other livestock insects were carried out and a vast amount of valuable information collected.

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* A more extensive obituary of the late Mr. Hearle appeared in the Canadian Entomologist for August 1934, Vol. 66 with details of his early life and training, by Arthur Gibson.

The late Mr. Hearle possessed a genial and lovable personality which made him popular in the communities in which he laboured and endeared him to all his friends. By his death this Society loses a very valuable member and generous contributor to its Proceedings and the country at large has lost an entomologist of outstanding ability, whose place it will be very hard to fill.

Besides his contributions to the Proceedings of this Society, Mr. Hearle published many articles in the Canadian Entomologist and was author of Pamphlet No. 147—New Series, "Warble flies and their Control in Canada" and joint author with C. R. Twinn of Circular No. 62—"Mosquito control in Canada." His work in the Fraser Valley is published in report No. 17 of the National Research Council, "The Mosquitoes of the Lower Fraser Valley, British Columbia, and their control."

Mr. Hearle leaves behind him his wife and three children to whom this Society extends its very deep sympathy.

W. DOWNES.

## A REVIEW OF PLANT QUARANTINE WORK IN BRITISH COLUMBIA.

By H. F. Olds

In order that the early history of Plant Quarantine activities in British Columbia should not be overlooked, permit me to give an outline of this work from its first inception.

In gathering up the threads of the past, and to get a clear conception of this early work, let us go back to the year of 1897 where we find "An Act" respecting the Provincial Board of Horticulture, cited as the "Horticultural Board Act" (1894 C. 20 S. 1) in operation.

This enactment was the result of two previous Acts regarding the Board of Horticulture, the first coming into operation about 1892 and which might be considered the first steps in British Columbia to protect the fruit industry in this province from the invasion of foreign pests and diseases.

In the wording of this Act it states that the Lieutenant-Governor in Council shall appoint a competent person with practical experience in horticulture, who shall be known as "Inspector of Fruit Pests."

There is much credit due to these first inspectors who were entrusted to carry out this work. Probably the first to receive the appointment to this post was Mr. Ernest Hutcheson of Ladner, B.C., in the year 1892.

Two years later he was succeeded by Mr. R. M. Palmer, who had charge of this work for eight years. Then in 1902, the late Thomas Cunningham was placed in charge, who retained this position until the year of his death in 1916, when the supervision of this service was entrusted to his assistant, Mr. W. H. Lyne, who during his tenure of office as Chief Plant Quarantine Officer under the Provincial Department of Agriculture, also acted as collaborator for the Federal Department, under the Destructive Insect and Pest Act, until his retirement on July 1, 1933.

To show the foresight of these earlier guardians, we find that as early as the year 1895, plans were made, and a Government Fumigation Station was erected, through which all imported plant life must pass for inspection and if necessary, fumigation. The late Thomas Cunningham, who was a member of the Board of Agriculture, supervised this work.

In the year 1900, the Federal Department of Agriculture, under the direction of the late Dr. James Fletcher, Dominion Entomologist, operated a separate fumigation chamber in Vancouver, under what was then known as the "San Jose Scale Act."

This fumigation chamber was erected adjoining the Provincial inspection station, the late Mr. Tom Wilson being placed in charge. The Dominion Department would receive, and fumigate these foreign importations, which would then be passed over to the Provincial Department for inspection.

This dual service was carried out by the two Departments for several years, when the work was co-ordinated and since that time up to August 1st, the service has been carried out under the supervision of the Provincial Plant Quarantine Branch, whose officers were acting as collaborators under the Dominion Destructive Insect and Pest Act.

In giving this record of our past Quarantine activities, in British Columbia, I wish to gratefully acknowledge records prepared by the late Mr. R. C. Treherne.

In the fall of 1932, the Provincial Agricultural Act and Regulations thereto were declared ultra vires and were rescinded. This left the Provincial Plant Quarantine officially fatherless, so that in the spring of 1933 negotiations were entered into between the Federal and Provincial Departments for the transfer of the Provincial Plant Quarantine Branch to the Federal Department, which was finally consummated on August 1 of last year, and this service comes directly under the supervision of the Secretary of the Destructive Insect and Pest Act.

In connection with the transfer of this service, there are still a few minor points to be settled, but the general procedure to be followed will be similar to that carried out in other parts of Canada.

The purpose of quarantines is still the same today as in the earlier days of its first inception, only the scope of the application of the principles involved has been broadened to meet present existing conditions, but the same fundamental purpose remains: i.e., the prevention of the spread of foreign pests and diseases that may be brought in on imported plants and plant products.

The final test of the value of any law is the ability to successfully execute all of its provisions, and quarantine regulations can best be enforced by a staff of inspectors sufficient in number to cover all trade channels where plants or plant products are permitted to enter.

## NOTES ON TICKS AND INSECT PARASITES OF GAME ANIMALS IN BRITISH COLUMBIA.

By E. R. Buckell
Dominion Entomological Laboratory, Vernon, B.C.

The Dominion Entomological Branch maintains a research laboratory at Kamloops for the special study of insects affecting man and domestic and wild animals.

The late Mr. Eric Hearle, who was in charge of this laboratory, made special studies of ticks, biting flies, warble and bot flies, lice and fleas; particular attention being paid to the part these ticks and insects play in spreading disease among man and animal; a subject upon which a great deal has yet to be learned, and one of very great importance to those interested in the welfare not only of man but also of domestic and game animals.

It is well known how insect-borne diseases may wipe out both man and animal over vast areas in such countries as Africa, and it is strongly suspected that here in Canada biting insects play a greater role than has hitherto been supposed.

During the past few years the studies being carried on in Canada and the United States have brought to light a lot of extremely interesting and valuable information in regard to the part biting insects and ticks play in spreading disease; especially such diseases as tularaemia and Rocky Mountain spotted fever.

Mr. Eric Hearle kindly supplied me with the information contained in this report concerning the ticks and insects which I actually found, and also concerning those that I might have been expected to find, on the game animals shot; and I am much indebted to Mr. Hearle for the information supplied.

It is desirable to get all the data we can on the parasites affecting wild animals, since so little is known of these and their relation to the increase or decrease of game. There seems to be little doubt that grouse, for instance, are in some seasons very seriously affected with ticks, **Haemaphysalis leporis palustris** Packard, and that these carry certain diseases at present very meagrely understood but which certainly have a marked effect on the abundance of these birds.

In the same way, it is believed that the throat maggots **Cephenomyia** spp. affecting deer and elk have been responsible in some years for a very marked reduction in these animals. Very serious infestations for instance, have been reported from Colorado and elsewhere in the United States and deer and elk have been noted with large numbers of these maggots in various parts of British Columbia.

At the present time we know very little about the actual economic effect of most of these pests, and it is only by systematic collecting that such data can be secured and that any possible control can be evolved.

Then there is another feature, and that is the fact that wild deer sometimes harbour parasites that seriously affect domestic animals and are one of the main means of distributing these parasites over large areas. It has been found for instance that liver fluke is very abundant in deer in parts of Vancouver Island—apparently the same species of fluke that affects sheep and cattle. All these are important factors and indicate that we certainly should know more of the parasites affecting game in British Columbia.

In this connection the recent publications of Dr. A. E. Cameron, University of Edinburgh, Scotland, and his associates, on the parasites affecting red deer in Scotland, are of interest. They have got together quite a mass of valuable information in this study and doubtless this information will be of great benefit to those interested in deer stalking in Scotland. It seems that somewhat similar information would be of value to us in British Columbia.

Having obtained permission from the Dominion Entomologist, Ottawa, to make a short trip for the purpose of collecting parasites from game animals for Mr. Hearle, I spent the last week in May, 1932, with a small party of bear hunters in the Shuswap mountains, near the headwaters of the Anstey, Seymour, and Eagle Rivers, having previously obtained a permit to shoot game animals at any time from the British Columbia Game Board.

The trip was not as successful as I had hoped it would be, on account of the unusually late spring and the great depth of the remaining snow. The result was that we had an exceedingly hard trip and it was fortunate that, although many mishaps occurred, none of the party or any of the pack horses were injured.

**Game Animals Shot and Ticks and Insects Secured:**

(1) **One large male Mountain Goat (Oreamnos americanus). columbiae** Hollister.

The main reason for wishing to secure a goat was to obtain a large number of specimens of the so-called Wood-tick (**Dermacentor andersoni,** Stiles,) for shipment to the tick-parasite laboratory at Hamilton, Montana.

Some years ago I was able, in company with Mr. Hearle, to visit this laboratory in Montana and to learn the exceedingly interesting work being undertaken there. In conversation with Dr. Cooley at this laboratory, he asked me to try and get him some wood-ticks from goats in B. C., as he wished to examine them and compare them with those taken among the goat rocks in Montana.

At this time the Game Department of the Province of British Columbia was differently organized and I knew nothing about the possibility of obtaining a special permit to kill a goat in the spring. However, while out bear hunting I had the opportunity of coming close to a number of goats, and shot one small goat in the hope of obtaining the desired ticks.

On examining the goat I found it to be a most disgusting sight, being literally a crawling mass of wood-ticks. They were on all parts of the body and many were already well engorged.

I cannot understand how any animal could exist with so many of these ticks feeding upon it, especially as this tick often produces paralysis on man and animal. I cannot but feel that the mountain goat must be immune from the injurious symptoms produced in other animals.

During the succeeding years, while spring bear hunting, I kept my eyes open as regards the tick situation, when in the goat-rocks of the mountains. I was truly astonished at the number of wood-ticks present in the goat-rocks once the real warm weather of spring had started. I found them crawling on me all day if the sun was out, and I have no doubt that the goats I saw in the vicinity were covered with them. No more goats were shot as I very much dislike to shoot such animals in the spring unless something of real scientific value can be obtained by so doing.

Early in the spring of 1932 I was informed by Mr. Hearle that the Hamilton tick laboratory in Montana would very much like to secure many hundreds of adult wood-ticks from the goat-rocks of British Columbia and I therefore asked that I be supplied with a permit allowing me to shoot game animals for scientific purposes.

Mr. Hearle informs me that one of the reasons we are particularly anxious to secure ticks from fairly high elevations and particularly from haunts of the Mountain goat, is that the authorities in Montana seem to think that there is a possibility that the very large ticks occurring at high elevations in the vicinity of goat-rocks may be slightly different to the ordinary **Dermacentor andersoni** Stiles, of the low valleys. There is a theory that these over-sized goat-rock ticks may have something to do with the added virulence of Rocky Mountain spotted fever which is found on the west side of the Bitterroot Valley in Montana. Apparently, except for the larger size, these ticks are morphologically the same as the common valley **andersoni,** but there may be physiological differences which render them particularly suitable hosts for "stepping up" the disease.

At any rate, it is a well known fact that Rocky Mountain spotted fever is about 75 to 80% fatal to human beings on the west side of the Bitterroot Valley, where mountain goats occur, and only from 4 to 5% fatal on the east side of the same valley where no goats occur.

For the above reasons we are naturally very anxious to secure all the data we can on the presence of the larger ticks in the various high goat ranges in British Columbia, as far as this is possible.

If large quantities of wood-ticks could be obtained, the Hamilton laboratory could crush them and inject the fluid into rabbits and tell us if the organism causing spotted fever is present in our B. C. ticks. There seems little doubt that it does occur, as they have definitely determined its distribution in the United States up to our border line.

Should the spotted fever ever appear in our tick infested valleys such as the Okanagan, in the virulent form found in the Bitterroot Valley, the consequences would be very serious, and we should be well advised to make every effort to ascertain all we can as to the prevalence of wood-ticks in the province and also whether the spotted fever organism is present in these ticks.

Another point in regard to the importance of tick studies in British Columbia is that they have found in Montana that the British Columbia strain of **Bacterium tularense,** McCoy, the organism causing tularaemia, and which Mr. Hearle secured from a snowshoe rabbit at Vavenby in the North Thompson Valley, is more virulent than any other strain that has been experimented with from various parts of the United States. Guinea pigs will often live for over a week or even a fortnight with some of these strains, whereas the British Columbia strain usually kills them within two or three days. The fact that our particular strain of tularaemia is so virulent, and that the only human case so far located in Western Canada was a very serious one, indicates the necessity for doing all the work we can on studies of the various carriers of tularaemia.

On May 25, 1932, after a rather hazardous climb, a large male goat was secured. I was rather afraid that I might not get the desired number of ticks as the spring was very backward and I had not found any ticks on my person during the previous day's hunting.

On carefully examining this goat I was extremely disappointed to find that I was too early and that no wood-ticks had as yet come out from their winter hibernating quarters and got onto the goat.

Having killed the poor old fellow I practically plucked him of his wool from head to tail, in an effort to find something, some lice or fleas, that would justify my taking his life, but I could find nothing at all.

I felt rather badly about this, as I particularly admire the goat and disliked taking his life even in the name of science. However, Mr. Hearle informs me that the goat appears to be particularly free from parasites other than the wood-tick, and that he can find no records from goats in the lists of sucking and biting lice for North American animals.

However, even negative results are often knowledge gained, and I will know better another time when to expect good results in the matter of collecting wood-ticks from goats.

(2) **One large male Mountain Caribou (Rangifer montanus**, Seton-Thompson.)

On May 26, 1932, having found out that any further quest for wood-ticks would be a failure owing to the cold, late spring, I turned my attention to caribou.

During the day some thirty caribou ot all ages were seen and I selected a bull from a group of five.

I hoped to obtain a caribou hide showing the holes caused by the grubs of the caribou warble fly **(Oedemagena terandi** Linn) which is usually found in great numbers in the backs of caribou in the spring.

I understand from Mr. Hearle that this warble fly has mainly been recorded from the Blue River district and that the grubs reach full growth by April or early May.

The caribou was carefully skinned but I found no trace of grubs beneath the skin nor of any visible exit holes in the skin. I felt that perhaps I was too late to find grubs and that the exit holes might show up after tanning and so packed the skin home. Unfortunately, before I could get anything done to it, it was entirely destroyed by pack rats.

After taking the skin to camp it was carefully examined but appeared to be absolutely free from lice or parasites of any kind. Mr. Hearle informs me that caribou may be infested with lice, but that he has been unable to find any reference to the Latin names of those infesting this animal, or whether it is infested by both biting and sucking lice.

As often happens when hunting, the animal was shot far from camp, late in the day, and nothing more than the skinning could be done that day. On the following day I returned to the carcass determined to find something of interest and was very relieved to find that, unlike the unfortunate goat, the caribou was not to disappoint me entirely.

In examining the throat and gullet I found a large number of large dipterous maggots, attached by hooked jaws to the membrane.

These proved to be the larvae of the caribou nostril fly, **Cephenomyia nasalis (C. trompe),** which were of particular interest since they appear to represent the most southern record for this species, as far as we know. Mr. Hearle informs me that he had previous indications that this fly occurred on caribou in the Blue River district.

These flies belong to the same genus **(Cephenomyia)** as the nostril fly found in the red deer of Scotland, and some of the grubs collected have been sent to Dr. Cameron in Edinburgh at his request.

I was rather disappointed in not being able to find any external parasites on the caribou, and as he appeared to be so completely free

from them, I did not feel justified in examining further specimens at that time although I was well aware that it need not necessarily follow that others in the vicinity would be free also, as often an old and weak member of a herd will be more heavily infested than his younger and more robust companions.

(3) **One Mule Deer (Odocoileus hemionus hemionus Rafinesque).**

On May 22nd, 1932, I was fortunate in securing a small Mule Deer, these not being at all common in this particular location.

The deer was skinned and the hide examined for parasites in camp. It proved to have a large number of biting lice **(Mallophaga)** on it.

These lice were determined for me by Mr. Hearle as **Trichodectes tibialis** Piaget. They were small, flat, brown lice, and were found singly, clinging head downward, to the base of the new growing hairs of the summer coat. As these lice seemed to be absolutely immobile, this was a very wise precaution on their part, as they would certainly have been shed on the winter hairs if attached to them. I never saw the least movement in any of the specimens collected and they died when placed in alcohol in position on the hairs.

The only other parasite found on the deer was one nymph tick, taken in its ear. Mr. Hearle informs me that this is probably a nymph of the winter tick (**Dermacentor albipictus** Packard), so plentiful upon range horses during the winter months. He further states that one would have expected to find on this deer a fair infestation of engorged adult females of the winter tick which sometimes remain on the host fairly late in the season at high elevations. Normally it is gone in the valleys before the end of May.

However, it should have been followed by the paralysis tick **Dermacentor andersoni** Stiles, adults of which should have been active in May or June at this elevation, but owing to the late season had not yet appeared from hibernation. Mr. Hearle further informs me that I might also have found specimens of the deer louse fly, **Lipoptera depressa,** Say. "This is very common on deer, but most of our records, of course, have been in the fall, which is natural since the specimens have been obtained in the hunting season. I have not very much information as to its life history and as to when it is most abundant on deer, but imagine that some specimens would be found on the animals at almost any time of the year. Larvae of throat maggots, **Cephenomyia** spp. (Possibly **C. trompe**) might also have been found."

(4) **Bears: Grizzly—(Ursus horribilis).**
**Black—(Euarctos americanus).**

During the collecting trip of 1932, I, personally, did not shoot a bear, although several chances at both grizzly and black occurred. I was able, however, to examine the skins of two black bears, and during the past few years I have shot and examined several grizzly and black bears.

Mr. Hearle informs me that I might have found the wood tick and also fleas upon bears, but that bear fleas are rare and very difficult to secure.

In all my examinations of bear skins I have never found anything in the way of parasites upon them, except an odd wood-tick. This, to me, seems a very curious thing, as I have shot grizzlies on slides frequented by goats and at a time of year when wood-ticks were very plentiful and could be found crawling on one's clothes while sitting on the slide where the bears were feeding. I am inclined to think that the bear is not favoured as a host for the adult wood-ticks, and in general, is very free from external parasites.

(5) **Rodents and other small mammals :**

During the trip of 1932 I did not have time to examine anything except the large game animals mentioned above, but the examination of some of the smaller mammals would certainly be worth while.

The wood-ticks only occur on large animals in the adult stage (early spring) and spend their immature stages upon small rodents. This district is particularly well stocked with chipmunks, Columbia ground squirrels (**Citellus columbianus columbianus** Ord) and Hoary marmots (**Marmota** spp.) I have also, on two occasions, secured a specimen of the British Columbia woodchuck (**Marmota monax petrensis** Howell) the only specimens I have ever seen. These were caught under the floor of the shack we stayed in.

Other small animals seen were Wolverine (**Gulo luscus** Linnaeus), Fisher (**Martes pennanti** Ervleben) and Coyote (**Canis latrans** Say).

The collection and study of the parasites attacking our game in British Columbia seems to be something very much worth while, as this is a phase of entomology that has never been given a great deal of attention.

Personally, my work in the Vernon Office on fruit, vegetable and range insects, does not allow me to do much collecting of animal parasites.

I am, however, extremely interested in the study of our game animals and never lose an opportunity to get back into the mountains.

Having now become more familiar with the kind of parasites I may expect to find, the times of the year in which they occur, etc., I feel that I could, on any future trip, make more use of my time and shall certainly welcome any chance to be of help in expanding our knowledge of the parasites attacking game animals in British Columbia.

# A PRELIMINARY REPORT OF THE LIZARD-TICK RELATIONSHIP ON THE COAST OF BRITISH COLUMBIA

By J. D. Gregson, Courtenay, B. C.

The Coast tick **Ixodes ricinus californicus** (Banks) during the past few years has been becoming of increasing importance in inhabited areas on the Pacific Coast. This fact is noted particularly in British Columbia, where much of the coast land, formerly uninhabited, is now being taken up for summer resorts and residential localities. An idea as to the extent of the tick situation was revealed by investigations made at the coast during the summer of 1933 and the following fall and winter, in continuation of a project of the Dominion Entomological Laboratory, Kamloops, B.C.

The coast tick appears to be distributed over the whole of southern Vancouver Island and coast of British Columbia. Tick bites have been reported as far up as Courtenay, V.I., (lat. 49° 40′) where a specimen was taken from the arm of the writer on May 20, 1933. Adults have been taken from deer thirty miles north of here at Campbell River. This is likely the most northerly record for the island, if not for the mainland coast.

The Malahat and Saanich districts of Vancouver Island appeared to be one of the most favourable localities for **Ixodes ricinus californicus.** The climate and geographical nature of both these places is characterized by its areas of dryness and roughness. These appear wherever the bedrock extends through the shallow layer of soil, and in the regions of rugged hills such as Malahat Mt. (3,000 ft.), Mt. Douglas and Mt. Tolmie. Needless to say, since precipitation is relatively light in the summer, and as these sloping hills have only a slight moisture-holding capacity, the humidity falls very low during the daytime.

Since the majority of ticks have been discovered only after they have been carried away from their surroundings, it is difficult to give a detailed description of their specific environment. The account of the habitat of the Coast lizard given later, however, will serve to illustrate further the type of land most suitable for them.

Enquiries made of various doctors and inhabitants of the district surrounding Victoria, B.C., revealed that the majority of people who were in contact with outdoor life had experienced tick bites. Little children had been bitten on several occasions, one incident occurring in the vicinity of Victoria. From all reports there, the ticks were most troublesome only during the winter and early spring months, mainly from the beginning of February on to the end of June. None were apparent in July and August, and berry pickers in the Malahat

district did not seem to be troubled by them. In the same area in the spring, Mrs. E. B. York stated that it was possible to pick up two or three ticks in a single walk.

West Vancouver appeared to be an ideal habitat for the coast tick, and possessed a type of land very similar to the tick-infested areas on Vancouver Island. Drags were made for adults in this vicinity during the hot weather of August, but gave negative results. Later, enquiries were made of Dr. J. M. McIntosh, Medical Health Officer for the City of Vancouver, regarding any trouble experienced in this locality from tick bites. A canvas of the Vancouver Hospital records revealed very little trouble of this description.

The next field trip to West Vancouver was made at the end of a week of warm spring weather on February 18, 1934, and a series of drags were made over dry grass along the P.G.E. railroad grade at Caulfield, the home of large numbers of the lizard. These proved highly successful, and a dozen adult ticks were captured in ten minutes, the number varying from one to three for a twenty-foot drag. Of these twelve, it is of importance to note that there were four pairs in copulation. The remaining four individuals were females. These drags were made at twelve o'clock noon. The sky was cloudy and the temperature registered 48 degrees F. Information obtained from inhabitants in this area revealed the fact that at this time of the year the ticks are particularly troublesome. Dogs suffered most and often had to have the ticks picked from them from day to day. The most satisfactory method of loosening them, according to one lady, was to dampen them with coal oil. Humans were less molested, but bites of these ticks were not uncommon among hikers. Although, in no known cases, have bites of these ticks produced serious results, there are several instances of bad ulcers having been caused by them.

It is thus seen that **Ixodes ricinus californicus** is confined to that part of British Columbia where there is a mild and humid climate. That the local temperature is also an important factor in the abundance of these ticks is indicated by their greater concentration on rocky slopes that receive the full heat of the sun. Whether their presence in such areas is due to the climatic conditions, or whether it is of a secondary nature, due to the relationship of the coast lizard, is not yet certain, and cannot be determined until more is known about the hosts of the early stages. To ascertain this would involve considerable experimental work and shooting of rodents, ground inhabiting birds, game birds and animals, etc., in the infested areas. Nevertheless, it is noteworthy that the habitat of the coast tick is almost identical with that of the coast lizard, and it is known that this lizard **(Gerrhonotus multicarinatus** Blainville) is at least one of the hosts for the larvae and nymphs of **Ixodes ricinus californicus.**

Since the distribution and environment of this lizard practically coincides with that of the coast tick, a description for the former will serve in an attempt to correlate it with that of the parasite.

At Victoria this lizard is very widely distributed, since the majority of the Saanich Peninsula and southern Vancouver Island is typical of its environment. Specimens were observed on the rocky slopes of Mt. Douglas, at a rock garden bordering Esquimalt Harbour, and about protruding rocks at Lakehill. Each of these places was exposed directly to the sun, and the rocks became very hot during the daytime. Vegetation was scarce about these areas, of which the dryness permitted only the growth of xerophytic vegetation. It may be noted, with reference to this, that on the coast the habitat of the arbutus is typical for that of the lizard and, in most cases, the tick.

The district where the lizards appeared most abundant, and where the writer did most of his collecting, was at West Vancouver. On any hot day individuals might be seen about the rocky regions extending along the north shore of Burrard Inlet, from West Vancouver to Point Atkinson. They were particularly plentiful along the disused grade of the P.G.E. Railway. This track leaves the shore level at West Bay, and from there to Caulfield, a distance of about two miles, it skirts along the foot of Hollyburn Ridge, some 200 feet above the sea. Its grade is made on a steep slope which is covered in the damper places by a luxuriant growth of coniferous trees, maples and ferns, but is also interspersed with bald rock prominences. In many places a cutting has been made through the latter, leaving a jagged wall of weathering rock on the north side of the track. This proved to be an ideal home for large numbers of lizards, who made their abodes in crevices in the wall of loose and cracked rock at the edge of the track. These cuttings were probably much more suitable than any districts on the island in that, besides possessing the desired heat, they were also kept continually moist by seepage from the hills above.

Frequently these lizards were found in forests and comparatively damp regions. The occasional one could be heard scurrying into ferns from the side of the highway at West Vancouver, and many could be heard among the salal and underbrush on Baby Mt. in the same district. One specimen was captured in the damp woods near the outlet of Shawnigan Lake, V.I. At Comox, a colony has been observed for several years living under driftwood on a sandy beach.

The parasitism of the Pacific Coast lizards by the coast tick was first brought to attention by Dr. W. L. Jellison of the U.S. Public Health Service. While engaged in field studies relative to the occurrence of Rocky Mountain spotted fever virus in California ticks, during March and April, 1932, he made numerous collections of **Ixodes ricinus californicus** in Madera, Monterey, San Benito, Santa Barbara, Santa Clara

and San Luis Obispo counties. Unfed adults were secured from vegetation in considerable numbers and also were found infesting dogs, horses and man. The hosts of the immature ticks he found to be the alligator and blue-bellied lizards, except in one instance when an engorged nymph was taken from a dog.

The early stages of these ticks attack themselves to the host from a position inside the lateral cervical pouch, where they remain concealed and protected until they have engorged. This external ear is situated halfway between the eye and base of the forelimb, and is in the form of a pit 1½mm. in diameter, extending about 2mm. into the body. Across the bottom extends the thin tympanic membrane. The lower portion of this external ear is covered by a fold of skin bearing small convex scaley grains, so that there is an internal pocket or "cervical pouch" which is considerably larger than the opening. This orifice is bordered in front and above by the projecting temporals, and behind by loose granular skin. It is to the interior caudal portion of this pocket that the ticks attach themselves. Microscopic sections of this area reveal very few blood vessels, contrary to what would be expected, and it is possible that lymph, instead of the large reptilian blood cells, are absorbed by the parasite. In no cases that have come to the writer have ticks been attached to any other portion of the body than that mentioned.

Inspections of **G. multicarinatus** have revealed the presence of **I. ricinus californicus** as a larval and nymphal parasite, although in no large numbers at the time and place where the studies were made. Two lizards captured and examined at Mt. Douglas, Victoria, and at Shawnigan Lake in the latter part of August were free from ticks. However, a specimen received from Victoria on October 15th had two engorged nymphs in one ear and one in the other. No ill effects were shown on the part of the host. Out of fifty-nine specimens examined from West Vancouver, only one was infested by a tick. This was observed on October 4th. It engorged until October 15th, when it dropped off. This date was undoubtedly late in the season for nymphal ticks, and it is probable that earlier in the season many more cases of parasitism would have been present. Certainly the number of adult ticks and lizards in the same area at West Vancouver would suggest this, particularly as there are few other animals in that area that would serve as hosts.

Dr. Jellison, in considering the same suggestion as to the importance of lizards to the immature forms of ticks states that "in a restricted area south of Monterey high school, Monterey county, where tick-infested lizards were numerous, over 250 adult ticks were collected from the vegetation in a few hours. In this area no rodents or other small animals that might serve as hosts to the immature ticks were seen, although they might have been present in limited numbers."

So far, the writer has been aware of no cases of lizards being infested by adult coast ticks. Experiments are being carried out in this respect to see if this is possible. The natural conditions appear suitable, since the lizards are known to appear out on the rocks during the early spring days. This is the time when the adults are most abundant.

Parasitism of lizards in Europe by **I. ricinus** is recorded by Nuttall and Warburton (l.c.) and by Neumann (1911). Dr. Brumpt, professor of parasitology of the University of Paris, has also used lizards for the rearing of **I. ricinus**.

I wish to acknowledge the assistance of officers of the Dominion Entomological Branch, particularly the late Mr. Eric Hearle, for data regarding **I. ricinus californicus**, and my thanks are due to Dr. Jellison for his kind permission to use information contained in his paper on "The Parasitism of Lizards by **Ixodes ricinus californicus**" which was read at the twelfth annual meeting of the Great Plains International Conference of Entomologists at Edmonton, Alta., in August, 1932.

## SOME METEOROLOGICAL OBSERVATIONS IN RELATION TO THE SPRUCE BUDWORM

By W. G. Mathers,
Dominion Entomological Laboratory, Vernon, B.C.

In 1927 the writer was detailed to investigate the occurrence of the spruce budworm, **Cacoecia fumiferana** Clem., in British Columbia. At that time several outbreaks of this defoliator were active in the province. However, during the summers of 1927 and 1928 field studies were confined to local infestations on the south eastern portion of Vancouver Island. Then in the spring of 1929 the writer's activities were transferred to an extensive infestation in the Barkerville district where, with headquarters at Stanley, field studies were continued each summer during the next four years.

The outbreaks on Vancouver Island occurred at sea level in Douglas fir-balsam stands while the Barkerville infestation was active in alpine fir-Engelmann spruce stands occurring at from 3000 to 4500 feet above sea level. In this latter region the beginning of the growing season was fully one month later than at the coast.

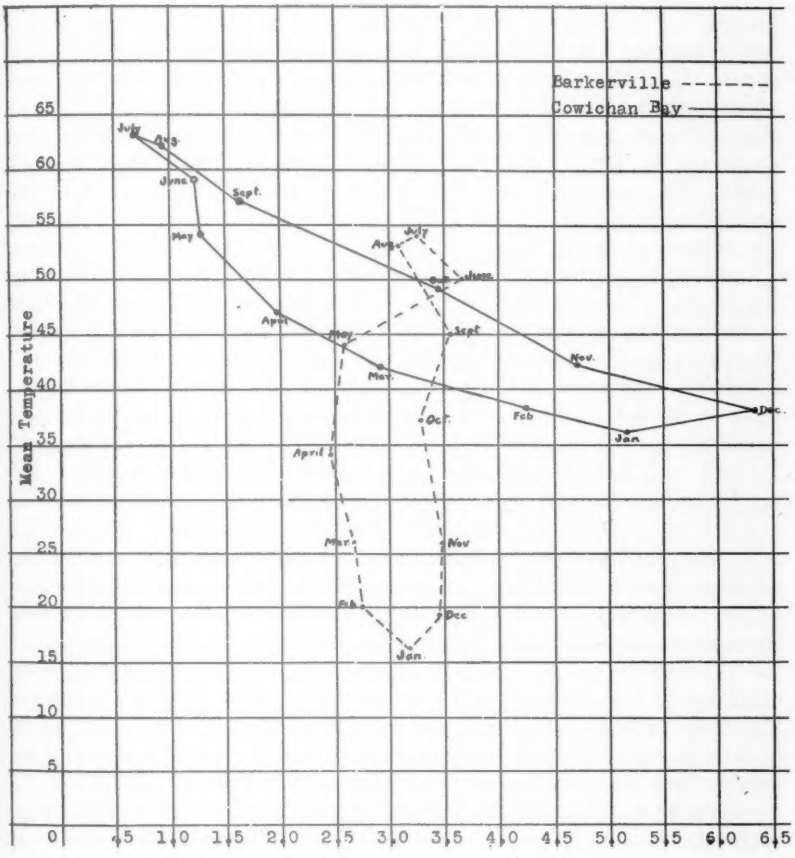
The marked difference in the climate of the two regions is indicated in the accompanying hythergraphs which are based on official government records taken at Barkerville over a period of 44 years, and at Cowichan Bay for a period of 18 years. In these graphs the vertical scale represents average mean temperature and the horizontal scale represents total precipitation.

In the Barkerville district the budworm is active in June, July, and August, whereas on Vancouver Island the period of budworm activity was in May, June and July. Comparing the weather for the years the field studies were made, we find an average mean temperature of approximately 52 degrees for the months of June, July and August in the Barkerville district and an average mean temperature of from 56 to 60 degrees for May, June and July on Vancouver Island. Moreover the total rainfall for the three months in the latter district only ranged from 2 to 3.5 inches while in the Barkerville district the rainfall for June, July and August averaged more than 10 inches and summer frosts were not common.

In the course of the studies under two such different types of conditions the influence of the climatic factors on the growth and development of the spruce budworm was very marked. The most important finding, and one which explains the persistency of the infestation in the Barkerville district under such apparent adverse weather conditions, was that in this locality the spruce budworm was found to

## HYTHERGRAPH SHOWING VARIATIONS IN CLIMATE

Between Barkerville, B.C., and Cowichan Bay, B.C.



require two years to complete its life cycle whereas the normal life cycle is complete in one year.

In the normal life cycle of the budworm, such as described in all previous accounts of this species and as found on Vancouver Island, the young overwintering larvae emerge from their hibernacula or overwintering cocoons in the spring, coincident with, or a few days before, the opening of the buds of the host trees. The larvae immediately commence to feed either directly on the new growth, if such is present, or by mining into the unopened buds. The feeding period under average conditions may vary from 30 to 40 days. Pupation occurs in a loose silken shelter spun among the foliage and the pupal period varies from 12 to 18 days. Egg laying takes place soon after the moths emerge. The eggs are laid in masses on the needles and hatch within 9 to 12 days. On hatching, the young caterpillars seek a sheltered nook such as between bud scales, under lichen, or at the base of twigs where it spins a hibernaculum in which it remains until the following spring.

However, in the Barkerville district in 1929, the young over-wintering larvae, although emerging about the middle of June at the time of the opening of the buds of the host trees, returned to hibernation after only developing to the third and fourth instars. These cocoons differ from the primary hibernacula only in their larger size. Then in June of the following year the larvae re-emerged and completed their development, the flight period and egg laying taking place in August. In 1931 and 1932 a similar two year cycle was traced in which the caterpillars of the new brood reached only the third and fourth instars in 1931 and then completed their development in 1932.

This prolonged life cycle was without doubt a direct result of the adverse weather conditions characteristic of the Barkerville district. In the field studies the influence of the climatic conditions was evident throughout the entire life of the budworm. The date of emergence of the caterpillars in the spring was governed by the existing weather conditions. For example, in the Barkerville district the first emergence was fully one month later than on Vancouver Island where more favourable weather was experienced. Moreover, at the coast infestation in 1928 when the mean temperature for May was approximately 56 degrees the first activities of the larvae occurred about ten days earlier than in 1927 when the average mean temperature for May was only about 52 degrees.

During spells of wet and cold weather the larvae were found to remain more or less dormant and to refrain from feeding. Hence when such conditions were general the rate of development was greatly retarded. For example, at Stanley in 1929, the average length of the larvae at the end of thirty days following the commencement of activity in the spring was still not over 5.5 mm., while at the coast, under more

ideal conditions, the average length of the caterpillars at the end of the first month was not less than 15 mm. The effect of inclement weather is also plainly shown in a comparision of the development of the budworm larvae at Stanley during the two years 1930 and 1932. At this station in 1930 rain occurred on 11 of the last 12 days of June and with an average mean temperature for the 12 days of 47 degrees, while in July of the same year the weather was much more favourable, the mean temperature for the month being 52 degrees. However, in 1932 the reverse was the case with rain on only 4 of the last 12 days of June and the mean temperature 51 degrees, while in July the mean temperature was only 47 degrees and rain was general. Hence in 1930 the budworm larvae developed very slowly in June and the first pupa was not recovered until July 15th. However, the first moth was taken on July 28th. On the other hand, growth was comparatively rapid in June 1932 and the first pupa was recovered as early as June 27th that year. During the next three weeks the daily maximum temperature at no time exceeded 66 degrees and further development was almost negligible, so that although the first pupa was taken almost three weeks earlier than in 1930 the first moth did not emerge until July 26th, just two days earlier than in the previous flight year.

The effects of adverse weather on the duration of the incubation period of the eggs were found to be similar, because in the Barkerville district in 1932 the length of this period ranged from 17 to 33 days whereas at the coast, variations of from only 9 to 12 days were recorded.

Unfortunately, the only available meterological records for the work on Vancouver Island are those of the official government recording stations, the nearest of which was several miles from the centre of the investigations. However, daily readings were made at Stanley during the summers of 1930, 31 and 32, and in addition hygrothermograph records were obtained during 1931 and 1932. To supplement these records the readings of a government station at Barkerville, also located in the infested areas, were available.

In attempting to correlate the rate of development of the budworm with these weather records the daily mean temperature was found to be the most satisfactory reading for the purpose.

At Stanley in 1932, where data was secured from 83 individually reared specimens, a fairly uniform relationship was found to exist between the duration of the pupal period and the average mean temperature. The average mean temperature for a pupal period of 16 days was 53.7 degrees whereas with pupal periods of from 33 to 35 days the mean temperature was 47.3 degrees. During the same season the mean temperature for an incubation period of 17 days was found to be 54 degrees and for a period of 26 days, 51.7 degrees. On Vancouver Island in 1928 the incubation period varied from 9 to 15 days with an average mean temperature of from 69 down to 62 degrees. However, in both

localities the intervening figures lacked the uniformity of those for the pupal period but such may be explained by the fact that the egg masses were present on trees in the open and so possibly subject to more or less direct sunlight.

In addition to computing the effects of the weather by using the mean temperatures an effort was made to establish the total amount of effective temperature, expressed in "degree days," necessary for both the pupal and egg stages. The total number of "degree days" for a given stage of development of an insect, is arrived at by taking each day from the commencement to the termination of the stage concerned, and by computing the number of degrees by which each day's mean temperature exceeds that of the threshold of development, and then summing the number of degrees so obtained for the whole period under consideration. As the threshold of development for the spruce budworm was not known the arbitrary figure of 42 degrees was adopted. Although fairly wide fluctuations occurred a certain uniformity in the totals was evident for each locality. At Stanley the total number of "degree days" varied from 178 to 214 for the pupal stage and from 206 to 264 for the egg stage. At the coast the number of "degree days" for the pupal period ranged from 272 to 311 and for the egg stage from 227 to 359.

Furthermore, as hygrothermograph records were available for the summer of 1932 at Stanley, the total number of hours occurring above 42 degrees were calculated for the pupal periods of the specimens reared individually that year. However, the resulting figures were of no value as an index to the effects of temperature on the development of the budworm. For instance only 294 hours occurred above 42 degrees during the pupal period of 16 days duration while 547 hours were recorded for the pupal period 35 days in length.

A quite interesting point is to be found in a comparision of pupal periods of similar duration in the two localities. Those on Vancouver Island experienced fully one hundred "degree days" more than for specimens at Stanley and the average mean temperature was also distinctly lower at the latter station. For example, the average mean temperature for a pupal period of 17 days at the coast was 60.3 degrees and the number of "degree days" 311, while for a pupal period of 16 days at Stanley the mean temperature was only approximately 54 degrees and the number of "degree days" 187. Somewhat similar results were obtained with the egg stage.

No definite explanation can be given for these variations. However, climatic factors without doubt play an important part, although the difference in host trees may have some influence and the possibility that the spruce budworm in the two regions may be of somewhat different strains cannot be overlooked.

This paper has been purposely confined to a discussion of the weather conditions as expressed by the temperature records. However, sufficient evidence has no doubt been presented to indicate the extremely complex relation existing between insect development and weather conditions. The need for more detailed studies of this relationship is quite apparent. In this regard a thorough investigation of the microclimatic conditions of the habitat in which a given species actually lives is most important. Only until such a time when such microclimatic conditions can be correlated with the standard meteorological observations will the latter be of full value.

The necessity for a new reliable method of computing the effects of variable temperature is also quite evident. The mean temperature does not present a true picture of the conditions while the summation of temperatures by means of "degree days" is, as now used, far from satisfactory. V. E. Shelford has done an enormous amount of work along these lines but his methods are too cumbersome to allow of their general adoption.

Climeographs, in which the horizontal scale represents humidity, and hythergraphs are gradually coming into more general use in the studying of distribution, fluctuations in the number, and seasonable development of insects. However, for such graphs to be of value, particularly in a study of seasonal development, the time unit should not exceed one week. Otherwise important variations in the weather factors will be lost.

## SOME FOOD PLANTS OF LEPIDOPTEROUS LARVAE
### List 2.

By J. R. J. Llewellyn-Jones

Prior to reading this second list of Food Plants of Lepidopterous larvae I have a few remarks to offer arising from the last list re **Halisidota argentata** Pack.

Having reported as secondary hosts Sallow (**Salix hookeriana** Barratt) and Flowering Currant (**Ribes sanguineum** Pursh.) a further testing was made in the spring of 1933. The above hosts were again accepted and normal imagines resulted.

It would therefore seem established that immature larvae, when deprived of their primary hosts, i.e., species of fir, will feed up successfully on the substitutes above cited.

Larvae were placed on cherry (garden varieties) and apple. The former was accepted and normal imagines obtained but the larvae on apple died, apparently from malnutrition. This latter result also befell a larva fed on thimbleberry. Pear was refused.

From the above it would seem that although the leaves of certain fruit trees are sometimes eaten these insects are unlikely to become a menace to the fruit grower.

In compiling this list my thanks are due to all members of the Society particularly Mr. G. O. Day of Duncan who willingly placed his breeding notes at my disposal; Mr. E. P. Venables, who together with his own findings forwarded a list which first appeared in the Bulletin of the Society in 1908; also officers of the Division of Forest Insects, Department of Agriculture, Vernon, B.C.

May I solicit the further co-operation of entomologists in the Province to enable this list to be made as comprehensive as possible. I would suggest that records be sent either to me direct at "Arranmore" R.M.D. No. 1, Cobble Hill, B.C., or to the Secretary of the Society who will, I am certain, forward them to me.

I append a schedule of abbreviations used in the following list. The initials of those members furnishing the records are placed in brackets after the record concerned.

G.D. G. O. Day, Sahlatston, Duncan, B.C.
E.P.V. E. P. Venables, Vernon, B.C.
M.H.R. Max H. Ruhmann, Vernon, B.C.
J.R.J. J. R. J. Llewellyn-Jones, "Arranmore"., R.M.D. No, 1, Cobble Hill, B.C.
R.V.H. R. V. Harvey.
J.C. J. W. Cockle.
E.A. E. M. Anderson.

G.W.T. Rev. G. W. Taylor.
D.D.A.V. Division of Forest Insects, Dominion Dept of Agriculture, Vernon, B.C.
W.D. W. Downes, Entomological Laboratory, Victoria, B.C.

## RHOPALOCERA

**Papilio rutulus-arizonensis** Edw. Willow, poplar, apple (J.C.)
**Papilio eurymedon** Luc. Ceanothus (J.C.) hawthorn (E.A.)
**Parnassius smintheus** D & Hew. Stonecrop (J.C.)
**Neophasia menapia** F & F. Pine (J.C.) Fir.
**Ascia napi-venosa** Scud. Cabbage (E.A.)
**Ascia rapae** L. Cabbage, turnip, etc. (E.A.)
**Anthocharis sara** Bdv., form **reakirtii** Edw. Arabis (R.V.H.)
**Eurymus eurytheme** Bdg. form **eriphyle** Edw. Clover (J.C.)
**Eurymus occidentalis** Scud. Clover (E.A.)
**Eurymus interior** Scud. In fir woods only (J.C.)
**Danaus mennipe** Hbn.
*plexipus* Auct. (L. partim.)
*archippus* Fabr. (Nec Cram.) Milkweeds.
**Oeneis nevadensis** F. & F. Lichens (E.A.)
*gigas* Butl.
**Brenthis myrina** Cram. Violet (E.A.)
**Euphydyas perdiccas** Edw. Common plantain (Plantago major L.)
*cooperi* Behr. Rib grass. (P. lanceolata L.)
**Euphydryas taylori** Edw. Valerianella (G.W.T.) Camassia (E.A.)
**Phyciodes campestris** Behr. Wild Aster (J.C.)
*pratensis* Behr.
**Polygonia satyrus** Edw. Hop (R.V.H.) poplar (E.A.)
**Polygonia faunus** Edw. Willow (J.C.)
**Polygonia zephyrus** Edw. Rhododendron, currant (J.C.)
**Polygonia oreas** Edw. Alder (E.A.)
a. **silenus** Edw.
**Hamadryas californica** Bdg. Ceanothus (J.C.)
**Hamadryas antiopa** L. Willow (J.C.) elm (R.V.H.) poplar (E.A.)
**Cynthia atalanta** L. Nettle (J.C.)
*Huntera* Fabr.
**Cynthia carye** Hbn. Hollyhock (J.C.)
**Basilarchia lorquini** Bdv. Cottonwood, apple (J.C.) Willow (E.A.) Crataegus (W.D.)
a. **burrisonii** Mayn. Willow (G.D.)
**Basilarchia archippus** Cram. Poplar, willow (E.A.)
**Stymon californica** Edw. Willow (E.A.)
**Mitoura nelsoni** Bdv. Strawberry (J.C.)
**Erynnis icelus** Scud. and Burg. Willow (J.C.)

## HETEROCERA

**Smerinthus cerisyi** Kirby. Willows in general (J.R.J.)
b. **ophthalmicus** Bdg.

**Sphinx galii** Rott. Willow Herb (Epilobium angustifolium L.)
a. **intermedia** Kirby.

**Sphinx lineata** Fabr. Fushsia riccartoni (hardy var. Vine Outdoor grape var.) (J.R.J.)

**Platysamia euryalus** Bdv. Willows, june-berry (G.D.)
a. **kasloensis** Ckll.

**Telea polyphemus** Cram. Apple, alder, willows, Flowering currant (Ribes sanguineum Pursh) (J.R.J.)

**Halisidota argentata** Pack. Douglas fir, Western hemlock, Norway spruce, Pinus Contorta (W.D.) will also eat cherry (garden vars.) possibly thimbleberry (Rubus nutkanus Moc.) (J.R.J.)

**Leptarctia californiae** Wlk. Chickweed, common plantain (P. major L.) will eat oak, willows, dandelion (G.D.) Blackberry (W.D.)

**Diacrisia pteridis** Hy. Edw.
*danbyi* Neum. Common plantain (P. major L.)
a **rubra** Neum. (G.D.)

**Apantesis ornata** Pack. Lettuce, knotgrass. Have been known to nibble at common plantain (P. major L.) (G.D.) dandelion and willow.

**Agrotis plebia** Sm. Dandelion (G.D.)

**Lampra sambo** Sm. Wild strawberry (G.D.)

**Polia adjuncta** Bdv. Wild strawberry (G.D.)

**Polia petita** Sm. Phlox (garden vars.) (J.R.J.)

**Graptolitha patefacta** Wlk. June-berry (G.D.)

**Graptolitha contenta** Grt. Oak (J.R.J.)

**Xylena cineritia Grt.** Willow (G.D.)
a. **mertena** Sm.

**Xanthia pulchella** Sm. Thimbleberry, rose (G.D.)

**Chutapha periculosa** Gn.
form **v-brunneum.** Balsam fir (G.D.)

**Hyppa xylinoides** Gn. Willows, wild cherry, rose, alder, flowering currant (Ribes sanguineum Pursh.), honeysuckle, june-berry, plantains, dandelion, red clover (J.R.J.)

**Nadata gibbosa** A. & S.
a. **oregonensis** Butl. Alder (preferred), maple, (Acer macrophyllum Pursh.) rose, june-berry, willow (J.R.J.O.) oak (W.D.)

**Ianassa pallida Stkr.** Willows, poplar, alder, june-berry, maple (Acer macrophyllum Pursh.), rose.

**Schizura unicornis** A. & S. Apple, plum, apricot (G.D.)

**Pseudothyatira cymatophoroides** Gn. Poplars, willows, june-berry.
form **expultrix** Grt. alder, rose, bramble (J.R.J.)

**Cymatophora improvisa** Hy. Edw. Wild cherry (G.D.)

**Cymatophora fasciata** B. & McD. Wild cherry (G.D.)

**Hemerocampa pseudotsugata** McD. Douglas fir (Pseudotsuga taxifolia (Lambert) Britton) (D.D.A.V.)

**Olene vagans** B. & McD. Apple, wild rose (E.P.V.).

**Stilpnotia salicis L.** Poplars, (Populus trichocarpa T. & G.), silver Lombardy and Carolina poplars, willow (Salix lasiandra Benth.) (D.D.A.V.)

**Drepana arcuata** Wlk.

a. **siculifer** Pack. Alder (J.R.J.)

**Cosymbia pendulinaria** Gn.

a. **griseor** McD. Alder (J.R.J.)

**Rachela bruceata** Hlst. Apple (E.P.V.)

**Rachela occidentalis** Hlst. Oak (J.R.J.)

**Coryphista badiaria** Hy. Edw. Oregon grape (G.D.)

**Diactinia silaceata** Hbn.

a. **albolineata** Pack. Willow Herb (Epilobium angustifolium L.) (J.R.J.)

**Hydriomena nubilofasciata** Pack. Oak (J.R.J.)

**Eupithecia vancouverata** Tayl. Arbutus (A. menziesii Pursh.) (G.D.)

**Nepytia phantasmaria** Stkr. Western hemlock (Tsuga heterophylla (Raf) Sargent) Douglas fir (Pseudotsuga taxifolia (Lambert) Britton) (G.D. & D.D.A.V.)

**Amphidasis cognataria** Gn. Willows, alder, maple (Acer macrophyllum Pursh.) flowering currant (Ribes sanguineum Pursh.) june-berry, wild cherry, gladiolus (J.R.J.)

**Erannis vancouverensis** Hlst. Oak (J.R.J.), hawthorn (Crataegus).

**Anagoga pulveraria** Linn.

form **occiduaria** Wlk. Willows (J.R.J.)

**Ellopia somniaria** Hlst. Douglas fir (Pseudotsuga taxifolia (Lambert) Britton), western hemlock (Tsuga heterophylla (Raf) Sargent), western red cedar (Thuja plicata Donn.), Sitka spruce (Picea sitchensis (Bong) Carriere), western white fir (balsam) (Abies grandis Lindley), vine maple (Acer circinatum Pursh.), red alder (Alnus rubra Bong.); also many other shrubs (D.D.A.V.), oak.

**Hyperetis amicaria** H.S. Willows, alder, wild cherry, june-berry, wild rose and sp. of vaccinium (J.R.J.)

**Hyperetis triangulifera**ta Pack. Flowering currant (Ribes sanguineum Pursh.)

**Euchlaena mollisaria** Hlst. Willow, buckthorn (Cascara) Rhamnus purshiana Dc.)

**Metanema quercivoraria** Gn. Oak (G.D.)

**Ambesia laetella** Grt. Snow-berry (Symphoricarpus), june-berry (Amelanchier) E.P.V.)

**Anacampis fragariella** Bsk. Wild strawberry (Fragaria spp (M.H.R.)

**Argyroploce nimbatana** Clem. Apple (E.P.V.)

**Cacoecia fumiferana** Clem. **Primary Hosts.** Douglas fir, (Pseudotsuga taxifolia (Lambert) Britton) Mountain Balsam (Abies lasiocarpa (Hook Nuttall); **Secondary Hosts.** Western white fir (Abies grandis Lindley), Englemann spruce (Picea engelmanni (Parry) Engel.), Sitka spruce (Picea sitchensis (Bong) Carriere), western hemlock (Tsuga heterophylla (Raf.) Sargent), scrub pine (Pinus contorta Douglas) (D.D.A.V.)

**Eucosma culminana** Wls. Wild rose, apple (V.P.V.)

**Jubarella danbyi** Hlst. Willow (G.D.)

**Mimeola tricotorella** Grt. In apple fruit (E.P.V.)

**Peronea maxima.** Apple (E.P.V.)

**Peronea variana** Fernald. Western hemlock (Tsuga heterophylla (Raf) Sargent) Douglas fir (Pseudotsuga taxifolia (Lambert) Britton), Sitka spruce (Picea sitchensis (Bong) Carriere), western white fir (Abies grandis Lindley), Amabilis balsam fir (Abies amabilis (Dougl.) Forbes), mountain hemlock (Tsuga mertensiana (Bong) Sargent), Engelmann spruce (Picea engelmanni (Parry) Engel. alpine balsam (Abies lasiocarpa (Hook.) Nuttall).

**Platyptilia pica** Dodecatheon pauciflorum Durrand. (G.D.)

**Platyptilia punctidactyla.** Dodecatheon pauciflorum Durrand (G.D.)

**Tortrix allenana** Fem. Alfalfa, apple (E.P.V.)

**Trachoma falciferella** Wls. Wild cherry, apple, (E.P.V.)

**Vitula serratilinella** Rag. In apple, fruit also in bee hives (E.P.V.)

# OBSERVATIONS ON NOMENCLATURE AND TAXONOMY OF COLEOPTERA

By Ralph Hopping
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Although the following remarks apply to the Coleoptera of America north of Mexico they are more or less true of the other orders of insects. The definition of nomenclature is "a system of names, as applied to any art or science." These names are supplied by our taxonomic workers.

In Coleoptera, we have had various check lists beginning with Melsheimer's list of 1853, and followed by Crotch's list of 1880, with Austen's supplement, listing 9704 species, rather quickly followed by Henshaw's in 1885 and his three supplements of 1887, 1889 and 1895, where the number of species is brought to 11,255. Then for a quarter of a century no list was published until in 1920 Mr. Chas. Leng brought out the revised check list of 18,547 species followed in 1927 by the first supplement and in 1933 by the second and third supplements. These three supplements added another 3,503 species, bringing our total to 22,050 for North America north of Mexico. During the past few years a number of taxonomic revisions have greatly reduced the number of species in some groups, but these have been more than balanced by the wholesale description of species by some authors. One outstanding increase in species in one genus is from 1895, when it stood at 126, to 1927 when 427 were listed. Most of this increase was due to one author and in my opinion is out of all proportion to recognizable forms The same thing occurs in many other genera. In fact up to 1927 one writer had nearly doubled our listed species. This implies a condition existing in our nomenclature where revisions are suppressing many more species than are described unless the taxonomic group remains nearly the same as it was in Henshaw's time.

It seems that taxonomic writers have lost sight of the object of these lists. They are supposed to be systematic lists of species, to enable entomologists to look up the literature and definitely determine insects submitted to them for identification. This is fundamental, for upon these identifications the economic entomologist must base his decision as to the status of the insect in relation to plant or animal life.

In addition to our enormous number of species, we have in our check list under certain letters a-b-c-d-etc., scientific names including a conglomeration of subspecies, variations, colour varieties and aberrations. Dr. H. E. Burke some years ago published an article on the various forms included under these so-called subspecies, but I have been unable to find it. By far the greater number are colour variations and should be suppressed.

In the field one finds that these colour variations are either sexual or common to the species in both sexes. It is certainly ridiculous to call one by the specific name and the opposite sex, of a different colour, by a subspecies or varietal name.

One author informs us that in one part of the country occurs a race and in another part occurs another race which he says deserves a subspecific name but at the same time informs us that in the intervening territory occurs every variation between his so-called races, but does not tell us what to call the variations, whether by the subspecific or specific name. Another goes so far as to erect keys to the colour aberrations under each group or species and give them each a technical name.

This so-called taxonomic work has given the authors of our last check list so much trouble that they have been obliged to introduce the following in one family to explain subspecific variations.

"1. Correlated with geographical distribution=subspecies.
2. Variations in colour pattern=aberration.
3. Variation in sculpture and colour of pubescence=variety.
4. Variation in general pigmentation of the exoskeleton=accident.

The use of the word "accident" is most interesting. Only one thing is omitted and that is the naming of deformed specimens. In time we might get enough of them to form a key. But what good is this doing the economic entomologist who wants to know what is doing the damage in his particular region?

A case in point is our common **Orsodacne atra** Ahr.. to which are given six varieties, subspecies, aberrations, or accidents, whatever you wish to call them, where all the variations may be found in one rose blossom freely copulating. Then there is the habit of referring to the typical specimens by repeating the specific name. Does it make it any stronger to say it twice, especially in a key.

This is just so much dead wood and some taxonomists have gone so far as to use four specific names. Probably in the majority of cases insufficient knowledge and the desire to name species, especially by those having insufficient material, is responsible for many specific names which finally have to be placed in the synonomy. A few words should also be said in regard to the use of the genital organs as a means of separation. Conservatively used they have proved useful in some families of the Coleoptera, but I know of one case where they were checked by others than the author and found, when properly mounted, to be identical and yet the author made three species although he acknowledged that he could not tell them apart from external characters. I think it is time we acknowledge that the male genital organs are subject to slight variations in the same species, and that these slight variations might look enormous when highly magnified.

Of course everyone realizes that each species should have a name but many of us seem to have a distorted idea of what is a genus and what is a species.

Characters wholly specific are considered generic when the existing characters barely suffice to separate the species; the species then descend to individual variations and lead to the extreme of separating as species, individuals with small differences in the shape of the maculation, or colour design, a little more closely punctured on the margin of the pronotum, etc. Many sexes are so separated.

This is a plea for a little more conservative policy in taxonomic articles. It is not the only one which has been made of late years and even as far back as Darwin's time. We all make mistakes but let us not be so anxious to be authors of species, and to see our names in print, as to lose all idea of proportion. Let us be a little more sure of our facts before rushing into print and not think that because we have a few dried specimens before us we can sit in a swivel chair and determine their exact position in the universe.

## THE FAMILY HISTORY OF NICROPHORUS CONVERSATOR WALKER

By Hugh B. Leech, Salmon Arm, B. C.

There does not appear to have been anything published on the habits of the stages of any Pacific Coast forms of the genus **Nicrophorus** Fab., hence even the very incomplete notes in this article may be worth recording. The data were secured in spare moments while the author was operating an Entomological Branch field station at Steelhead, a small settlement in the hills some 9 miles north of Mission, B. C.

The living accommodation at the camp was a two-roomed homesteader's cabin; the room containing the stove and "bed," had a ceiling of long cedar shakes, and during the exceedingly wet weather of late May and early June, the warm attic made an ideal home for numerous mice Specimens were trapped rather continuously for several weeks, and those of May 25th-29th were placed on the ground under small boards in the clearing around the cabin. The intention was to attract some of the rarer **Carabidae,** but pairs of red-and-black burying-beetles responded more freely.

The species concerned is **Nicrophorus defodiens** Mannerheim, which according to Hatch (3) may be only the North American subspecies of the European **N. vespilloides** Herbst. Dr. Hatch has named seven aberrations (variations in colour pattern) of **defodiens,** and gives a key for these and five previously described variations, but I do not care to follow his disposition of the form **conversator** Walker, (5) since he is not in accordance with the original description. Hence I am considering all the specimens here reported on, as belonging to **conversator** Walk.

As previously mentioned, dead mice were placed under pieces of board, where they were soon discovered by the **Nicrophorus.** The beetles, (only a single pair was found associated with any one mouse) immediately proceeded to dig under the carcass, and to sink it below the surface of the ground. Next an almost spherical chamber was hollowed out around the body, giving the beetles sufficient space to move freely; the board formed the roof of this cell, and on removal left a perfect view of the interior. Unfortunately the actual burying process was not witnessed, but it seems reasonable to suppose that both parents took part in the work; though Furneaux (1) writing of the English **N. humator** Goeze, gives a rather idealistic description in which the males alone undertake the digging operations.

Once the cell was finished, the beetles proceeded to remove all hair from the mouse; this was done very thoroughly. The body was then compressed into an egg-shaped form, with the head, legs and tail so

completely moulded in that no one organ was discernible. It is possible that while denuding the carcass, and later fashioning it into a compact mass, the beetles may apply a somewhat preservative saliva, for in all cases observed, the mouse flesh was still very fresh looking when the **Nicrophorus** larvae were as much as half grown; and this in one example was over three weeks after the animal had been killed.

The eggs were not seen, but larvae which obviously had only just emerged were found crawling over one meat ball on June 21st. They soon gathered at the top and began to feed, gradually making a cup-shaped hollow; this depression deepened and widened steadily during the ensuing days, as the larvae rapidly increased in size. And it was at this time that a most interesting fact was noted; the parent beetles, instead of leaving when the carcass had been buried and the eggs laid, remained to guard their progeny! This is in absolute contradiction to Dr. Hatch's statement (*2*): "**The Nicrophorini** . . . . have the habit of assembling in small numbers under small carcasses and, by removing the earth underneath the carcass, gradually cause it to become buried. Thereupon the eggs are laid, and the adults move on."

From the time that the cell had been completed, one of the beetles stood watch on top of the food supply, while the other crawled around lower down, carefully examining and re-examining all parts of the carcass. When the eggs had hatched and the larvae had begun to feed, the beetle on guard covered them most effectively, and reminded one strongly of a frightened hen and her brood of chicks. As the larvae grew and widened the depression in the meat, the parent had more trouble in straddling the cavity, until finally it became impossible and a position had to be taken on the side. At about this time the second beetle left the family, though in every case one stayed until the larvae were ready to pupate. It would seem very likely that one parent, probably the female, maintained guard at the top of the cell, while the male attended to the lower part, and was the first to leave. This idea was not verified, as there is practically no observable difference in the front tarsi of the two sexes of this species, and it was thought that an examination of the terminal abdominal segments of the live beetles might so upset them as to cause desertion of the brood.

There can be no doubt but that the object of the careful attention by the parent beetles is to prevent the development of other beetle larvae and of fly maggots. It is notable that no maggots were found in any of the carcasses used by **Nicrophorus.** And although small **Silphidae, Catops basillaris** Say, and **C. simplex** Say, simply swarmed around the dead mice, their larvae were unable to develop until those of the burying beetles were almost ready to leave. It is presumed that the **Nicrophorus** destroyed the immature stayes of the Catops as fast as they appeared.

When fully grown the larvae entered the soil to pupate, but at some distance from their food supply. In each case a very definite path was made across the loose surface soil, from the rearing cell to the edge of the board, beyond which it very quickly faded out. This indicated that all the larvae left at the same point, and was verified on July 3rd, when one family was found "on the move." The larvae were halfway to the edge of the board, and one parent beetle was in attendance; but in addition to the path behind them there was a rough one in front, and this surely must have been made by the beetle. Such apparent foresight seems rather too much to expect of the clumsy-looking **Nicrophorus,** and the path in front of the larvae may have been accidental; another season's observations would clear the matter.

Just how far the larvae wander, and how deeply the pupal chambers are situated, is not known. One brood of 15 were removed when fully grown to a large jar of damp sandy soil, and all transformed and emerged successfully. Each larva made an oval pupal chamber, devoid of any silken lining, and with a smooth hardened inner surface. These cells were at depths of from three to seven inches below the surface, but digging to a greater depth all around the brood locations in the field did not disclose any pupal cells.

In a few cases dead mice were placed in empty jam tins sunk to their rims in the earth, and partially covered with pieces of old bark; pairs of **Nicrophorus conversator** Walk. soon took possession. Here again the mice were stripped of hair and consolidated into an oval mass; but the larvae did all their feeding at the lower surface, instead of hollowing out a cavity at the top. The large chamber and excess of light probably caused this change of habit. What occurs when a large carcass, such as that of a dog, is used by numerous pairs of the beetles, would be interesting to determine. Surprisingly little food is consumed by the larvae, relative to the size of the beetle which finally emerge. Fifteen young constitute an average brood, and this number attain full development on the body of one mouse, and even then leave an appreciable refuse pile.

The larvae feed entirely on dead flesh. Furneaux says that with **N. humator** Goetz, the beetles first gorge themselves on the carcass to be used, but this is not the case with the **N. conversator** Walk. studied. No evidence was found that the adults fed on the meat which they were preparing for their brood; in fact to the contrary. But this habit might vary with the quantity and nature of the food supply. Specimens were seen feeding on the dead bodies of the huge slugs so common in the damp coastal woods, but no attempts were made to bury these slugs for egg-laying purposes. The fifteen reared beetles were kept alive for three weeks on the very unnatural diet of fresh pork sausage, and were then killed purely for convenience sake.

Referring the reared specimens to Dr. Hatch's key to the aberrations of **N. defodiens** Mann., we find that of six males and nine females :

1 male and 3 females run to aberr. **nunenmacheri** Hatch.
3 males and 5 females run to aberr. **lateralis** Port.
2 males and 1 female run to aberr. **gaigei** Hatch.

With a good series the aberrations so intergrade that it becomes almost impossible to say whether the anterior fascia is continuous or broken, or to draw a line between "inner end of anterior fascia large" and "inner end of anterior fascia reduced." In fact the points of separation become so evanescent that it seems almost futile to attempt to segregate varying specimens in this manner. Divisions on clear-cut characters are desirable, but the naming of every phase of an extremely variable species is surely more suited to the study of genetics than to normal systematic entomology.

In conclusion, I would suggest that the stages of **Nicrophorus conversator** Walker are very hardy, easy to rear ,and do not seem to have any parasites. The adults are, almost without exception, infested with a species of an active red mite, much like the **Gamasus coleoptratorum** so common on the English "Dor" beetles. These mites probably eat the filth sticking to the hairy undersides of the beetles, and they are often extremely numerous—328 were removed from one **conversator** adult. They do not seem to bother their unwitting coach-horses, and certainly must benefit by such a convenient means of wide dispersal. Schaupp (4), writing in 1881 of **N. tomentosus** Web., said "All the larvae were full of louse-like parasites, which seemingly did not do much injury to the larvae, but sucked out the pupae all of which shrunk and died. Of fifty larvae I obtained not a single imago." It is probable that the reference here is to a species of mite similar to that found on the beetles at Steelhead.

To any of the members of the Society who may feel inclined to study the habits of the several species of **Nicrophorus** present in B.C., I would urge very strongly that the larvae be watched carefully, and, when fully grown, be removed to a deep container filled with soil. This will save the investigator from having to dig up half an acre of ground during the hottest part of the summer.

**Acknowledgments**

I am indebted to the Dominion Entomological Branch for permission to use for this article the data secured while in their employment; to Dr. M. H. Hatch for copies of his publications; and most particularly to Messrs. Ralph and George Hopping for help in many ways, and on very many occasions.

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## NOTES ON THE BLISTER MADE BY ERIOPHYES PYRI NAL.

By A. D. Heriot

The blister for which the blister mite is responsible is a condition where the thin epidermis of the leaf is raised from the underlying tissue.

We know, when examined in June, that these blisters each have a little hole in them, and are inhabited by mites. The natural inference is, that the mites have burrowed beneath the epidermis through this hole. On the other hand, we know that when examined in May, before the leaves are fully developed, that many of these blisters have no holes in them, and many have holes but no mites in them. Moreover, the idea of the mite forcing an entry through the epidermis, is entirely out of keeping with the type of mouthparts pertaining to these mites. These consist of a pair of reduced palpi, between which protrude the short needle-like stylets, which are about one fifteenth of the diameter of those of an aphis. These stylets can indeed make a puncture, but a puncture that is as small relatively to the mite, as the proverbial needle's eye is to the camel. It would be as reasonable to assume, that the mouthparts of an aphis are capable of directly making a hole through the leaf, by which the aphis could pass through from one side to the other, as that the mite can accomplish a similar performance through the epidermis. We also know that similar mites with similar mouthparts can do little more than irritate. Some incite the epidermal cells to grow complementary cells in the guise of deformed hairs, masses of which form what is called an "erineum" that give the family name **Eriophyidae** to these mites. Others, by exciting a subdivision of cells, produce strange galls of various types compared to which the blisters we are considering are very simple contrivances. The irritation that the blister mite appears to inflict on the cells of the growing leaf appears to merely cause their enlargement. In approaching this question of the mites' entry through the epidermis in an indirect fashion we shall for the moment divert attention away from the mite and the leaf and turn it to the twigs.

Everyone is acquainted with the little corky spots on the twigs which are its lenticels. These, under the magnification necessary for examining the mite, appear as very rugged eruptions of tissue that have broken through the epidermis. These lenticels are to the twig what the stomata are to the leaves, namely, respiratory organs. The stoma is, however, a highly specialized epidermal cell with a slit-like aperture which opens and shuts with great nicety, very different to the porous eruption of cells that forms the lenticel.

The lenticels originate beneath one or more stomas of the epidermis when due to some unexplained stimulus certain cells of the underlying tissue commence to divide and proliferate which cause this mass to break through a stoma.

Returning to the leaf with this information about lenticel formation, we shall find that a somewhat similar rupture of the epidermis can occur by the mite stimulating the cells of the underlying tissue beneath a stoma to enlarge. This underlying loose tissue of the mesophyll of the leaf is an aggregation of cells among and around which air spaces abound. An expansion in the size of these cells must expel the air from these interstices which, contrary to expectations, does not escape through the stoma. This specialized cell is so constructed that it automatically balances the pressure of the air within and without, by two shutters. Any unusual air pressure exerted from within would close the lower shutter, preventing egress yet opening the shutters on the surface; and vice versa.

Our contention may be summed up as follows: The mite incites cell enlargement of the loose mesophyll cells which expel air from between them, the air pressure created closes the stomata, raises the epidermis from the underlying tissue and the epidermis subsequently ruptures at a stoma; air pressure in this case taking the place of the complementary tissue which ruptures through the epidermis to form a lenticel.

We have a mounted slide of a portion of the epidermis over an unruptured blister, which shows some of the stomata of the epidermis much enlarged with the shutters wide open on the surface and completely shut below. Our sections of blisters show also the cells of the mesophyll of the leaf greatly enlarged in the vicinity of mites.

What the stimulus is that enlarges these cells we cannot conjecture. We have observed the mite standing on its abbreviated head as though possibly irritating the aperture of a stoma or the cells beneath.

There is little doubt that it is in some such way that these holes in the blisters are made, but when made the mite does not immediately enter. The first generation of mites from the eggs, each make a number of these blisters which can best be incited during the period of leaf growth. Sometimes one or two eggs are found in a blister, just beneath the orifice, which suggests that the mites with their peculiar method of oviposition may drop these through the aperture without wasting the valuable time of blister-making by a needless entry and exit. All we know for certain is that the blister forms without an entrance, that the entrance holes are not due to burrowing, and that these blisters remain uninhabited for many days.

## THE BEDBUGS OF BRITISH COLUMBIA

By G. J. Spencer

In the January number of the "Canadian Entomologist" for 1930 I published a short article on "The Status of the Barn Swallow Bug, **Oeciacus vicarius** Horvath" in connection with its attacks on human beings towards the end of the swallow nesting season or after the birds have migrated.

Since that date I have made several collections of bedbugs in this province and I think the list of possible species is now complete. Moreover, in the case of two of the species, the swallow bug and the bat bug, the collections include all the developmental stages from egg to adult with the exuviae; these stages I hope to describe in a forthcoming paper. For the present it will suffice to record a few notes about each species.

**Species 1. Cimex lectularius** Linn. The Occidental Human Bedbug.

A vast amount has been written about this ubiquitous insect which I refer to here as the Occidental human bedbug as opposed to **Cimex hemiptera,** the Oriental species. **Lectularius** seems to be sparsely but widely distributed over this province and crops up in camps, especially where transient labour is employed. It is carried from place to place, especially to hotels, in suit-cases or in bundles of bedding; I once discovered a couple in a parcel of otherwise clean clothes fresh from a Chinese laundry. The species occurs frequently in lumber camps where it is often exceedingly difficult to control on account of the jerry-built bunkhouses through whose walls any gas used in fumigation readily escapes without getting rid of all the bugs. Reports are to hand of old bunkhouses and shacks being deliberately burned by the owners as the simplest way of destroying the hordes of insects. I have seen the walls of a bunkhouse absolutely plastered with the specks of their droppings, and have painfully noted the myriads of insects issuing forth at night from every crevice in the walls and from the bunks themselves. A condition as serious as this is not tolerated nowadays; however, I have one record from an engineer where such a condition prevailed as recently as 1931, and another in spring 1933 from a boarding house similarly infested.

**Species 2. Cimex hemiptera** F. **(rotundatus** Sign.). The Oriental or Tropical Bedbug.

This species is usually longer, narrower and darker than **C. lectularius.** My samples are from India, and while I have not yet taken this insect in this province I think it more than likely that it may be readily found in Vancouver, where the Oriental population is con-

siderable and is constantly being reinforced by new arrivals from India, China and Nippon. I have questioned several Chinese and Nipponese but they are even more reticent than most people about these insects; one man assured me, however, that Nipponese houses in Vancouver are sometimes infested with bedbugs and that new arrivals bring them in amongst their personal effects. All his promises to secure specimens of this insect from the homes of his countrymen have so far come to naught.

**Species 3. Cimex pilosellus** Horvath.

This is the not uncommon bat bedbug of North America and seems to attack several species of bats. I have rarely found it on the animals themselves, but it may readily be taken from their roosting places in trees or in buildings. One of my records is from the loose bark of a cedar tree where bats were in the habit of sleeping. Another record shows a very well known summer hotel in the Dry Belt whose log construction afforded splendid hiding for bats. Up to the time of our visit in July, no less than 72 bats had been destroyed because they harboured the bugs which swarmed into the neighboring rooms through cracks in the plaster, especially in one of the bathrooms. Although human beings had not been actually bitten by the bugs, the guests seemed to resent their presence and the management was much concerned over the situation. The bat in question was **Eptesicus fuscus fuscus** Beauvois.

From the log roof of a root cellar near Lytton in the Dry Belt I obtained a large number of the bugs, which were occupying a deserted termite nest whose tunnels afforded them splendid protection. There were five of these same bats roosting immediately below the termite nest but no bugs were found on the animals themselves, although all stages of the insects occurred in the termite nest. This brood was taken in August.

To date, I have no record of anyone being actually bitten by this species of bedbug.

Very large specimens of this same insect, in fact the largest of all the bedbugs I have, were taken by that ardent mammalogist and ornithologist, Mr. Kenneth Racey of Vancouver, from specimens of the bats **Lascionycteris noctivagans** (Le Conte) the silver haired bat, and **Eptesicus fuscus pallidus** (Young) the pale brown bat, which were captured in July, 1931 in a talus slope on Anarchist Mt. near Keremeos. There were 10 specimens of these bugs, all females, 4 on **pallidus** and 6 on **noctivagans,** attached by their beaks firmly implanted in the bats' skin with their bodies sticking up at right angles to the skin, practically concealed in the long dense fur behind the ears. The bats were found in two separate locations at Keremeos.

**Species 4. Oeciacus vicarius** Horvath.

This is the widely distributed bedbug of swallows' nests in North America, which I reported from the nests of eave swallows **(Petrochelidon lunifrons** (Say) in 1930. 1. and which Dr. Herbert Osborn 2, 3 reported as early as 1892 and again in 1906 from the nests of barn swallows **(Hirundo erythrogastra** Bodd.). I have since taken them from barn swallows' nests from widely separated points in the province. My records show that these insects breed abundantly in the substance of these nests but especially in eave swallows' nests, where all stages may be found in July; by the end of August, all the eggs have hatched. The bugs, in all instars, occur in nests from which the birds have flown in August and must remain there all winter, although I cannot say at present if all stages survive the winter. Even if some of them do survive the winter, it is likely that birds migrating from the south bring a fresh stock with them in spring (when we consider the case of the bat bugs I have just mentioned), firmly adhering to their hosts.

This species certainly bites human beings when it becomes abundant even when the swallows are still present, but especially when the birds have migrated. (Spencer 1.) At times these bugs are very numerous; in one of the famous roadhouses up the Cariboo highway they swarm over the ceilings of some of the rooms when the birds have left and form flat masses over a foot in diameter. Such a condition, however, prevails only where nests are extremely numerous, running up into several score. Generally within one week or ten days after the birds have left, the bugs scatter to hiding places in the roof and are not found again until the following season when the swallows return.

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3. Osborn, Herbert, Bul. 5, N.S., U.S. Div. Ent., 1896, p 161c,

**Acknowledgment**

I am greatly indebted to Dr. Herbert Osborn for sending me records of his publications concerning these bugs, and to Dr. F. C. Bishopp of the United States Department of Agriculture for having the bugs from Keremeos identified for me.

## ADDITIONS TO THE LIST OF B. C. HEMIPTERA

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Since the first list of B. C. Hemiptera and Homoptera was published in 1927 (Proc. B. C. Ent. Soc. No. 23) a number of additional species have been recorded in literature. Many others are mentioned in the following list for the first time as occurring in British Columbia. Four of these appear to be European introductions. Most of the newly recorded species belong to the Hemiptera. Only a few species have been added to the list of Homoptera and there is much need of further collecting in this order.

The assistance of the following in making determinations is gratefully acknowledged: Dr. C. J. Drake, Dr. H. H. Knight, F. D. Klyver, P. W. Oman, Dr. H. M. Parshley, G. S. Walley.

### Order **HEMIPTERA**

### Family **CYDNIDAE**

**Geotomus uhleri** Sign. Summerland, 30. V. 32 (A. N. Gartrell.) In Can. Nat. Coll.; det. G. S. Walley.

### Family **PENTATOMIDAE**

**Neottiglossa tumidifrons** Downes. Victoria, 7. VI. 23 (W.D.); Goldstream, 15. IX. 27 (W.D.); Vernon, 10. VI. 18 (M.H.R,)

This species has previously been confused with *sulcifrons* and *cavifrons* neither of which are known to occur in British Columbia.

### Family **ARADIDAE**

**Aradus quadrilineatus** Say. Princeton, 24. V. 24 (Auden); det. Parshley.

**Aradus paganicus** Parsh. Kelowna, 19. I. 23 (W.D.), Penticton, 23. I. 25 (W.D.) Hibernating in numbers under outer flakes of bark of dead *Pinus ponderosa*, especially near the ground; det. Parshley.

### Family **TINGITIDAE**

**Acalypta saundersi** Downes. Goldstream, 15. VII. 26. (Saunders). One dead specimen among detritus at edge of reservoir; det. Downes.

**Acalypta nyctilis** Drake. Lorne 28. VII. 25 (Richmond). In a field cage surrounding Engelmann spruce; det. Drake.

**Teleonemia nigrina** Champ. Agassiz, 16. VII. 33. (R.G.), on *Pentstemon* spp.; det. Drake

### Family **ANTHOCORIDAE**

**Acompocoris feratis** D & H. Kaslo. Proc. Biol. Soc. Wash. 39, pp. 30-46).

**Tetraphleps profugus** D & H. Kaslo. (Ibid.)

Family **MIRIDAE**

**Dacerla downesi** Knight. Jordan Meadows, Vanc. Id. at 1700 ft (W.D.); det. Downes

**Polymerus basivittis** var. **pallidulus** Knight. Chilcotin, 23. VI. 29 (G.J.S.); det. Knight.

**Platylygus grandis** Knight. Malahat, 30. VIII. 29 (W.D.); det. Knight.

**Dicyphus discrepans** Knight. Saanich, 3. V. 18. (W.D.) Vanc. 25. VIII. 26; det Knight.

**Ceratocapsus downesi** Knight. Saanich, 11. IX. 18. (W.D.); det. Knight. Formerly recorded as *Ceratocapsus fusiformis* Van D.

**Lopidea taurina** Van D. Midday Valley, VI. 24 (K.F.A.); det. Knight.

**Lopidea yakima** Knight. Midday Valley, VI. 24 (K.F.A.); det. Knight

**Lopidea aculeata** Van D. Saanich, 23. VII. 29 (W.H.P.); det. Knight.

**Lopidea mohave** Knight. Merritt, 11. VIII. 23 (R.H.); det. Knight.

**Heterotoma meriopterum** Scop. Victoria, 6. VIII. 33, 17. VII. 34 (W.D.) Swept in large numbers from broom (*Cytisus scoparius*) at Mount Douglas. (European); det. Downes.

**Melanotrichus concolor** (Kirsch). Nanaimo, 6. VII. 32 (W.D.) Victoria, 6. VIII. 33 (W.D.) Very abundant on broom; (European; recorded also from Massachusetts); det. Knight.

**Melanotrichus atricornis** Knight. Lillooet, 28. V. 26 (J. McD.) on sage brush; det. Knight.

**Deraeocoris schwarzii** Uhl. Summerland, 18. VII. 23 (W.D.); det. Knight.

**Deraecoris piceicola** Knight. Barkerville, 14. VIII. 21 (E.R.B.), Stanley,

**Plagiognathus suffuscipennis** Knight. Stanley, 22. VII. 32 (W.G.M.); det. Knight.

**Microsynamma bohemani** (Fall.) Duncan, 17. VII. 27 (W.D.) Swept from willows, bed of Cowichan River; det. Knight.

Family **SALDIDAE**

**Lampracanthia obscura** Prov. Victoria, 20. V. 25 (W.D.); In damp meadows under stones; det. Downes.

Family **BELOSTOMATIDAE**

**Belostoma flumineum** Say. Salmon Arm, 10. V. 29. (H.B.L.); det. Downes.

Family **CORIXIDAE**

**Callicorixa audeni** Hungerford. Adams L. 20. VII. 25. (Auden) (Can. Ent. Sept. 1928, p. 229).

**Arctocorixa modesta** Abbott. Vernon, 26. IX. 19. (W.D.); det. Walley.

Order **HOMOPTERA**

**Family MEMBRACIDAE**

**Gargara genistae** (Fab.) Victoria, 6. VII. 33 (W.D.); Swept from broom (*Cytisus scoparius*) at Mt. Douglas. (European); det. Downes.

Family **CICADELLIDAE**

**Idiocerus scurra** (Germ). New Westminster, 21. VII. 22 (R.G.); det. Downes.

**Twiningia scrupulosa** Ball. Saanich, 23. VII. 24 (W.D.); det. Oman.

**Eutettix incertus** G & B. Duncan, 22. IX. 25 (W.D.); det. Oman

**Phlepsius decorus** O & B. Merritt, 11. IX. 25 (W.G.M.); det. Oman.

**Phlepsius extremus** Ball. Goldstream, 28 IV. 26 (W.D.); det. Oman.

**Thamnotettix ciliatus** Osb. Cowichan, 22. IX. 25 (W.D.), in tidal meadows; det. Oman.

**Eupteryx melissae** Curtis. Victoria, 6. XI. 26 (W.D.), on *Salvia officinalis.* (European); det. Oman.

**Erythroneura ziczac** Walsh. Mission, 10. IX. 24 (W.D.), on Willow; det. Oman.

Family **CHERMIDAE**

**Aphalara rumicis** Mally. Chilliwack, 19. VII. 25 (Whittaker); det. Klyver.

**Aphalara vancouverensis** Klyver. Duncan, 29. VI. 22 (W.D.), host unknown; det. Klyver.

**Aphalara nebulosa kincaidi** Ashmead. Chilliwack, 20. V. 26 (Whittaker), host unknown.

**Euphyllura arctostaphyli** Schwarz. Merritt, 25, VIII. 25 (W.M.), on *Pinus ponderosa*; det. Klyver.

**Psyllia parallela** Crawford. Chilcotin, 1. IX. 30 (E.R.B.); Chilliwack, 15. 2. 23 (Whittaker), hosts unknown; det. Klyver.

**Psyllia astigmata** Crawford Thormanby Id., 8 VIII. 25 (Whittaker), host unknown. Esquimalt, 22 IX. 27 (W.D.) from wild cherry; det. Klyver.

**Psyllia caudata** Crawford. Vancouver, 28. VII. 22 (W.D.), host unknown; det. Klyver.